TOURO COLLEGE & UNIVERSITY SYSTEM

The Touro Teacher

Volume 1 *Spring 2017*

Article 6

2017

The History of American Mathematics Education

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In the history of the United States, one of the biggest areas of public contention has always been education. Politicians, educators, and parents have been debating every aspect of education for years. Within the broad picture of education, no field has been more controversial than mathematics education. By examining three distinct time periods in the history of American math education, as well as the approach used today, a clearer picture of the future of math education will emerge.

In the 1920s, American math education was based on the progressive educational approach (Klein, 2003). In the early twentieth century, William H. Kilpatrick, an education professor at Teachers College at Columbia University and a student of John Dewey, the founder of progressive education, set down the principles of progressive math education in his book Foundation s of Method, published in 1925. In accordance with the dictates of progressive education, Kilpatrick did not believe that teaching math to all students sharpens their mental acuity. He believed that math should be taught only if there was a practical value in it or the student demonstrated a particular interest in the subject (Klein, 2003). According to this belief, Kilpatrick proposed that algebra and geometry should no longer be taught "except as an intellectual luxury" (as cited in Klein, 2003, p. 3). He stated that mathematics is "harmful rather than helpful to the kind of thinking necessary for ordinary living" (as cited in Klein, 2003, p. 3). In 1915, as head of a team of educators tasked with solving the problems in American math education, Kilpatrick recommended that mathematics be eliminated from the curriculum altogether, except for in the case of a select few students (Klein, 2003).

In the 1930s, Kilpatrick's approach to math education took off. Based on the Activity Movement, which incorporated the ideas of progressivism, elementary schools began to integrate subjects and stopped teaching a separate mathematics curriculum (Klein, 2003). (High schools were more resistant because teachers were specialized in a specific area and were unwilling to integrate subjects.) Some Activity Movement educators went as far as to deny the need to teach basic arithmetic, like the multiplication tables (Klein, 2003).

In the 1940s, problems with Kilpatrick's philosophy became apparent. It was somewhat of a public joke that the army had to provide basic arithmetic courses for its recruits because they were so deficient in core math skills (Klein, 2003). This led to the development of the Life Adjustment Movement, which modified math progressivism to allow for classes in practical math, such as taxation, insurance, and budgeting, but still nixed classes in algebra, geometry, and trigonometry (Klein, 2003). By 1949, this adjusted progressive movement

had much support from leading educators (Klein, 2003).

By the 1950s, however, attitudes towards progressive math began to change. American students were deficient in math literacy, and the enrollment of high school students in algebra, geometry, and trigonometry courses had been steadily decreasing throughout the previous decade (Klein, 2003). In the early 1950s, a new movement began to germinate. Instead of allowing educators alone to decide the mathematics curriculum (or lack thereof), under "New Math," as it was called, mathematicians became involved in the process of returning to an intellectual approach rather than a practical one alone (Klein, 2003). It emphasized abstract mathematics, rather than the practical math of the previous era (Loebenberg Ball, 1991). The focus was on the "why" of math, a much more theoretical approach (Papakonstantinou, n.d.). However, the movement gained very little recognition until 1957, when the U.S.S.R. launched Sputnik, the first-ever space satellite (Klein, 2003). This was a major blow for the United States in the "Space Race" with the U.S.S.R., and it called public attention to the poor state of math and science education in the public school system (Klein, 2003).

In 1958, Congress passed the National Defense Education Act to try to increase the number of math and science majors. It also gave funding for school construction (Klein, 2003). That same year, the American Mathematical Society set up the School Mathematics Study Group (SMSG) to help develop a curriculum. They developed a high school curriculum, and eventually an elementary school one, as well (Klein, 2003). The New Math course of math education was very formal; although it promoted higher math skills, evidenced by the introduction of a calculus course in high school, it placed little emphasis on basic math or practical applications. In some ways, the New Math era was a 180 degree tum from the progressive math movement that preceded it; it focused on a concrete math curriculum, rather than discovery learning, and it promoted advanced math (Klein, 2003).

A third period in math education carried through the end of the twentieth century, specifically the 1990s. The era began in 1989, when the National Council of Teachers of Mathematics (NCTM) released a set of standards for mathematics, which became known in the 1990s as the NCTM Standards, or just the Standards (Klein, 2003). The idea of the Standard s to create a set of principles about math education values (Loebenberg Ball, 1991). It divided math education into three distinct groups: kindergarten through fourth grade, fifth grade through eighth, and ninth grade through twelfth (Klein, 2003). The standards listed areas which should receive more attention, and areas which should receive less. For example, in the first group, the NCTM felt that more emphasis should be placed on meanings of operations, operational sense, and mental computations, and less stress on long division, paper computations of complex numbers, and rote memorizing. One of the biggest changes that the Standards proposed was the use of calculators in all grades; the document proclaims that "the new technology not only has made calculations and graphing easier, it has changed the very nature of mathematics ..." (as cited in Klein , 2003, p. 9).The leaders of the NCTM

conceded that students would still need to have some pen-and-paper math skills, but this concession does not make its way into the actual propositions for classroom implementation of the Standards (Klein, 2003) .

The NCTM Standards were based on the constructivist educational theory (Feldman, 1996), which is a more modern form of progressivism (Klein, 2003). They focus on student- based, discovery learning, believing that students are blank slates who construct their own knowledge, and the only knowledge they will remember is that which they discovered on their own (Klein, 2003). This was the theory that was applied to math education in the 1990s. Unlike progressive education, though, the NCTM Standards employed a very specific math curriculum that included algebra, geometry, and trigonometry, but merely chose to teach that curriculum in a constructivist manner (Klein, 2003).

The *Standards* were published at the end of the 1980s following general public displeasure about the low mathematical level of entering employees and the poor performance of U.S. students in math compared to those in other countries, causing them to be significantly behind in economic competition. The country was looking for standards that could fix the problems, and the Standards fit the bill (Klein, 2003). Within a short period of time, they had been endorsed by many public organizations. With the publication of two follow-up documents, one in 1991 and another in 1995, most states began to align their math curricula with the one set forth in the Standards, and by 1997, the transition was largely done (Klein, 2003).

The National Science Foundation (NSF) began the implementation of the Standards (Klein, 2003). They provided a number of substantial grants in order to change math and science education in public schools. The Statewide Systems Initiative, launched in 1991, was designed to align state math and science education with the Standards. It worked remarkably well (Klein, 2003).

In January 2002, President George H.W. Bush began a new era in American education with the passing of No Child Left Behind (NCLB) legislation (Public Education Network [PEN], & National Coalition for Parent Involvement in Education [NCPIE], n.d.). This was to be the culmination of the work started by the NCTM Standards. NCLB set nationwide standards for education and implemented the idea that each student must exhibit "normal yearly progress" in order to continue to the next grade. It set down rigorous standardized testing in order to measure progress and hold teachers accountable for their students ' work (PEN, & NCPIE, n.d.). This became the theme of American math education in the twenty-first century; standardized testing dominates the American educational scene.

In January 2011, the New York State Board of Regents approved the Common Core Standards for kindergarten for twelfth grade. New York is currently one of 46 states to adopt some form of these standards. According to the Common Core manual, the standards "focus on results rather than means" (New York State Education Department [NYSED], 2010, p. 12). The Common Core takes the idea of standardization to the next level in that it standardizes the educational curriculum

across all schools and all grades in the state. It focuses on promoting thinking skills, leading to a more rigorous math curriculum in which students are expected to be able to understand the material and use it to solve difficult word problems (NYSED, 2010, p. 12).

Unlike progressive education, current education places on upper-level mathematical skills, especially on the high school level. Discovery learning is still promoted, but only within the framework of a specific curriculum. There are some elements of New Math; the intellectual approach to math is much more present than the practical one. However, the current ideas of standardized testing is uniquely an outgrowth of the N CTM Standards. Education is becoming progressively more standardized.

Despite NCLB and Common Core promises to revolutionize math education, American students' performance in mathematics remains low compared to students in other countries (Teicher Khadaroo, 2013). One researcher at the Wisconsin Center for Education Research suggests that methods such as problem-based learning as opposed to lecturing may improve this, but implementation of new strategies has been slow. The Common Core has seen a tremendous drop off in passing rates among students. Prior to its implementation, 55% of students passed reading, and 65% passed math; in 2013, those levels dropped to an abysmal 31% passing rate in both reading and math (Teicher Khadaroo, 2013). Based on these numbers, what is the future of the Common Core? Only time will tell, and many groups are urging patience, claiming that things may get worse before they get better. However, the Common Core's hold on New York State math education seems to be skating on thin ice right now.

Throughout the history of the United States, math education has been a fundamental issue that influences the next generation's productivity and growth. The progressive movement, the New Math era, and the NC TM Standards set down three approaches to teaching math, and the NCLB-based Common Core standards dominate the modern era. While there is no doubt that progress has been made since the 1920s, the future of math education is still uncertain, and reforms will likely be made. Overall, the words of James Caballero sum up the importance of math education: "I advise my students to listen carefully the moment they decide to take no more mathematics courses. They might be able to hear the sound of closing doors" (as cited in Lombard, n.d.).

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